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FOREWORD

One of the outstanding biological phenomena of the past year, the disappearance of the eel grass along much of our Atlantic seaboard, has scarcely been mentioned in botanical literature.[1] We are consequently particularly glad to be able to present the following summary of observations by Mr. Clarence Cottam, Assistant Biologist of the Bureau of Biological Survey, who has made a special study of this problem. This sudden and nearly complete dying out of a native plant calls to mind almost involuntarily the destruction of our native chestnut by the bark disease, and is no less interesting because as yet no causal organism or condition has been discovered.

N. E. S.

DISAPPEARANCE OF EEL GRASS ALONG THE ATLANTIC COAST

Clarence Cottam
Bureau of Biological Survey

Eel grass (Zostera marina) is a salt-water or brackish-water flowering plant belonging to the pond-weed family. Under normal conditions it grows in dense masses on the extensive mud flats, which at low tides are barely covered with water, or even exposed, but which often are covered to a depth of 10 feet or more. It ranges on our Atlantic coast from Beaufort, N. C., northward to southern Labrador, with outlying stations on southern Greenland, Labrador, James Bay, and the west coast of Hudson Bay at Cape Eskimo at about latitude 61 degrees. It also occurs on our Pacific coast and in northern Asiatic waters as well as on the European coast, including the northern Mediterranean.

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[1] Recently a short note by Wm. Randolph Taylor appeared in Rhodora. (Epidemic among Zostera colonies. Rhodora 35: 186. May 1933).

Economic Worth of Eel Grass

The effects of the recent disappearance of eel grass along most of the American Atlantic seaboard have forcibly brought to our attention its economic importance and the intricate relation it bears to other aquatic life.

It is used as a compost for fertilizer and in normal years thousands of tons are harvested for use in refrigerating and other insulation, as well as for upholstering and packing. It is reported to have been used in the manufacture of quilts and mattresses and also is valued by fishermen and coast farmers as a material for banking up houses, filling between the walls of ice houses and stables, and bedding domestic animals.

It is said that between 700 and 1,000 tons of this material were taken from one limited area of the Canadian coast, and that between 2,000 and 3,000 tons were shipped annually from the Province of Nova Scotia to one Boston firm.

That the removal of the dominant plant in any area will materially modify the ecology and physiography of that region is obvious. That eel grass aids in preventing erosion is shown by the fact that since its disappearance many coastal areas have undergone considerable change in surface features.

Many animals and plants are largely dependent on eel grass for both food and cover, and its failure in certain areas is naturally bringing about the disappearance of many forms of aquatic life there. Practically all life along these coastal areas is affected to some extent, either directly or indirectly. This plant is normally the staple (more than 80 per cent) winter food of sea brant and is an important food of Canada geese and black ducks and to a lesser extent of scaups, redheads, and other waterfowl along our coasts. While brant and geese have suffered considerably as a result of the eel grass disappearance, the various fishing and mollusk industries also have been seriously affected.

Cause of Eel Grass Destruction

The cause of the destruction of the eel grass is not known, though many theories have been suggested. Changes in water salinity and temperature probably have contributed directly or indirectly to the disaster. It may be significant that the eastern United States for some time has been going through a period of abnormally high temperatures. While proof is lacking, it does seem possible that some alteration of one or more of the physiochemical factors involved in the relationship between eel grass and the surrounding water, with its solutes, has occurred and has caused or favored the observed destruction.

History and Extent of the Disappearance

Midwinter of 1931-32 brought to the Biological Survey the first reports of a shortage of marine food plants of waterfowl along the Atlantic coast. In response to reports that geese and brant were starving in the Pamlico Sound area, the writer made an investigation in this section late in January, 1932, and found that eel grass was practically gone from both Pamlico and Core Sounds, though other marine or brackish-water plants were apparently unaffected. It was later learned that other coastal areas were similarly affected.

For a short period during July, Mr. A. C. Martin, of the Biological Survey, made an inspection of conditions at Barnegat Bay, N. J., and during a portion of December the writer visited Long Island, N. Y., and a portion of New Jersey. During January, 1933, he revisited the coastal area of North Carolina, and during part of March and April he continued his field studies from Maryland to Maine.

Information obtained in the field and reports from cooperators[2] indicate that the factor or factors responsible for the death of the plants may have been operating over a long period. However, the conspicuous dying out occurred almost abruptly in most localities in 1931 and 1932, with some evidence of this in 1930 in a few restricted areas. This condition was noted immediately following an almost unprecedented period of drought, low tides, and calm weather. It seems that in midsummer of 1931 (in most localities) the leaves of the eel grass became somewhat darkened, broke from their roots, and washed ashore in great windrows. It was reported that in Pamlico and Core Sounds, N. C., very little drift material washed ashore after the first week of September, 1931. Information available shows that the malady did not strike all areas during the same season; it can be said furthermore, that there are protected pockets that have not yet been affected. With a medium such as water for dispersal, however, the epiphytotic has spread with marked and alarming rapidity.

Dr. Fredrick F. Fish of the Bureau of Fisheries advises that the eel grass "Gradually died out during the summer of 1931 in many localities on Cape Cod. In some, such as Hyannis Bay, it appeared abundant as usual in 1931, but failed to grow during the spring of 1932." Mr. Robert A. Goffin, the official collector for the Fisheries Laboratory at Woods Hole, in a log book record of his activities, writes that "In some areas the eel grass disappeared during 1930, had disappeared in all areas during 1932... In some areas there was a total disappearance noticed from one summer to the other. I have in mind the Eel Pond, Woods Hole, and head of Great Harbor, Woods Hole, where in the summer of 1931 there was some grass, but it had totally disappeared in 1932." He mentions specifically Katama Bay, and notes that on August 21, 1931, he found the eel grass very scarce, and that on September 19, 1932, he could find no eel grass in this area.

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[2]Acknowledgment is made to the Bureau of Fisheries for its cooperation in obtaining information relative to the disappearance of the eel grass.

Mr. Goffin further writes that "During 1930 there was a total disappearance of eel grass from an area of about four acres from Northwest Cutter on the north side of Naushon Island."

Dr. Neil E. Stevens, of the Bureau of Plant Industry, writes that at Millers Cove, in north Buzzards Bay, Massachusetts, "Eel grass was very abundant in September, 1931, and wholly lacking in September, 1932."

Dr. Willard C. Greene, of the Massachusetts Conservation Association, has informed the writer that he first observed a diminution in the eel grass on Cape Cod late in 1930.

The writer found considerable differences in the condition of eel grass in various bays along Long Island, N. Y. While all the bays visited were seriously affected, Shinnecock Bay showed decidedly more eel grass than any of the others, and from reports it appears that this bay was not affected until some time after the others. Further, this same area seemed to present a more serious progress of the disease in the short period between December, 1932, and April, 1933, when the writer inspected conditions there. Shinnecock Bay is said to have been decidedly less salty than any of the adjacent bays until recently, when a new inlet washed in.

Eel grass destruction was most pronounced along Long Island in the summer of 1931. However, Mr. Harold Squires, a fisherman of South Hampton, stated that he has noted a gradual dying out of the eel grass in Peconic and Flounders bays since 1928, with the most abrupt and noticeable decline late in the summer of 1931.

An observer from New Jersey reported that he noted a decline in the eel grass in Barnegat and adjacent bays in 1930 and that the decrease to 1931 was gradual. In the New Jersey Courier, of December 9, 1932, is an item to the effect that there was no eel grass in the bays at that time and that geese and brant were pulling up sedges to eat the roots. The paper further notes that the plant was also very scarce during the previous winter (1931-32), which would indicate that the disease must have been present early in 1931. Reports from Maryland, Virginia, and North Carolina also indicate that the eel grass died out along most of their coastal areas in 1931. Dr. O. L. Austin Jr., of the Biological Survey, while feeding, trapping, and banding waterfowl on the Maryland coast in February, 1931, did not notice any diminution of the eel grass. From the actions of the brant, which were abundant, it appears that they were finding sufficient food.

It thus appears that the diminution of this important aquatic angiosperm was noted along our Atlantic coast from New Jersey to Maine before it was apparent in areas to both the north and the south. It should also be stated that there are areas along most of our Atlantic seaboard that are still being attacked. While it does not disprove, it certainly does not give added weight to the opinion sometimes advanced that the disease is of southern or tropical origin, brought north by ocean currents or tropical fishes. It should be stated, however, that experienced fishermen along most of our coast are reporting influxes of southern fishes.

While the malady appears to be just as severe in diseased areas from Maine northward, it probably did not develop in most of these areas until after denuding much of the southern coast. The Portland Press Herald of July 7, 1932, states: "Last summer [1931] it [eel grass] was nearly gone. This summer it has absolutely vanished. Channels that have always grown rankly with the tall grass and which have been unnavigable to motor craft may now be traversed with ease." Quoting a lifelong resident of the coast, the paper continues, "There has been no grass for two years." This would indicate that a portion of the Maine coast must have been affected at least as early as 1930.

At present there is an unprecented scarcity of living eel grass on the coast of Nova Scotia, Prince Edward Island, and all of New Brunswick except the extreme north. According to Dr. Harrison F. Lewis, chief Federal Migratory Bird Officer of Ontario and Quebec, the scarcity of this plant in areas where it is usually abundant is known "To extend as far north on the eastern shore of New Brunswick as Tabusintac Lagoon, Northumberland County, which is north of the estuary of the Miramichi River." In his official report he further writes: "In September, 1932, I personally observed this scarcity at Tabusintac, but on the same day failed to find any evidence of unusual scarcity at Caraquet, which is a little farther north, on the southern side of the Baie de Chaleur." At this date there was no scarcity on the north shore of the Gulf of St. Lawrence, nor along the coast of Newfoundland. Dr. Lewis concludes that "The northern boundary of the area of scarcity would seem to have been situated, in September last, across the Gulf of St. Lawrence, with its western extremity just south of the Baie de Chaleur and its eastern extremity just north of Nova Scotia."

Dr. A. G. Huntsman (Biological Board of Canada, Progress Reports, 1932, no. 5, p. 11-14), in writing of the "Disease in Eel Grass," states that the diseased "Condition seems to have been general from Northumberland strait southward.... We have observed the condition in Charlotte County, N. B., on the Bay of Fundy, and in Westmoreland County, N. B., and Prince County, P. E. I., on Northumberland Strait, and at Halifax, N. S." Dr. Huntsman adds that the scanty growth on the Bay of Fundy at St. Andrews and on the outer coast of Nova Scotia at Halifax indicated injury previous to this year (October, 1932). Further, this same writer records: "As the disease has been active for two years in the rather cold waters of the Bay of Fundy, there is no reason apparent for its failing finally to invade the northern part of the Gulf of St. Lawrence."

Throughout this affected area, from Beaufort, N. C., northward to the Gulf of St. Lawrence, there are local sections, such as estuaries and the mouths of some of the rivers, in which the sea-water is markedly diluted by fresh water, where there still exist dense stands of apparently normal and healthy eel grass. The upper Chesapeake south of Baltimore and Annapolis is an example. Only time can tell whether these areas will be affected.

All reports indicate a normal and healthy supply of eel grass on the Pacific coast.

Disappearance of Eel Grass in Other Countries

From France, Messrs. E. Fischer-Piette, Roger Heim, and Robert Lami (Note préliminaire sur une maladie bactérienne des Zostères. Comptes Rendus Acad. Sci. Paris. 195:1420-1422. 1932), state that Zostera marina, which has always been abundant in the memory of man, and which was still abundant in September, 1931, suffered almost total destruction in the winter season of 1931-32. They add that during the summer of 1932 this crop partially recovered but during November (1932) its regression was reaffirmed. It is interesting to note at this point that Zostera nana, which occurs in these same waters, was not affected.

These French scientists report the distribution of the disease along the European coast as covering not only the entire coast of Brittany, where it was first recorded, but also nearly the entire Atlantic coast of France and Holland. The Mediterranean coast of France appeared to be unaffected in December, 1932. These authors are of the opinion that because the disease occurred along the North American Coast for more than a year before the European Coast was affected it is of American origin.

Mr. J. Sutton, in the "South Australian Ornithologist" for January, 1931, p. 25, writing of an outing on Lake Alexandrina and the Coorong from October 18 to 23, 1930, states that at Younghusband Peninsula all the "swan grass (Zostera)" [possibly Z. mulleri] had mysteriously and entirely died out. He mentions that in March, 1925, a journey through this same area had to be curtailed because the dense growth of Zostera clogged the boat's propeller.

Is Eel Grass Returning?

Conditions of eel grass in various sections of the coast at present differ widely. There are extensive areas where considerably more than 99 per cent is dead and the remainder badly diseased and obviously on the decline. Such a condition was noted at Woods Hole and Buzzards Bay and in smaller sections on the coasts of Long Island, Maine, and New Jersey. Other areas where it appears that the grass had died out almost completely now show a good crop of seedlings, but practically no mature plants. Great Bay and Grassy Bay, N. J., are examples of this and in places show a new growth of 5 to 25 seedlings to the square yard. It remains to be seen what the summer will do to this. Along part of the coastal area of Pamlico Sound, particularly near the mouths of rivers, the eel grass shows a decided improvement over conditions there a year ago. This adds some encouragement to the hope that the disease will shortly pass.

Past Periods of Eel Grass Scarcity

There is a wide difference of opinion regarding the past history of the abundance of eel grass. All information, however, points to the fact that in the memory of man there has been no period of scarcity at all comparable with the present one. Many fishermen and coastal sportsmen

assert that there has always been a good crop of eel grass, while other apparently reliable observers maintain that this has not always been the case. It seems that there have at least been local periods of scarcity along much of the coast.

Mr. H. E. Perkins, of Shelter Island, N. Y., who has records covering a period of eighty years, wrote the Biological Survey under date of January 17, 1933, that in 1894 at Penobscot, Maine, on the northern branch of the Bagaduce River, "The mud flats were smooth with no grass on them, but from then on the grass kept growing longer and thicker until it got so you could not row a boat through it." He claimed that the year 1850 showed little or no eel grass and that there have been three periods of eel grass scarcity in the last eighty years.

It is interesting to note that a State game warden from this same general section of Maine recalls a time "Probably twenty-five years ago" when the eel grass was almost as completely gone from this area as it is now.

Two fishermen from Cape Cod gave record of the grass in Poponesset Bay being nearly gone some eighteen or more years ago. The writer met many old fishermen who report that while there never was a time of such widespread eel grass scarcity as now, in one or more years the supply has been much below normal. Reports of years of scarcity are frequently heard along all sections of our coast. A number of older sportsmen recall a winter when brant were observed feeding in the meadows. This has never been known except during a period of eel grass scarcity.

The Diseased Plant

There seems to be a considerable difference in the virulence of the disease in different sections. Those plants most severely attacked appeared wilted and contained little chlorophyll. The entire plant seemed to be affected and disintegrating. More commonly the disease begins as a grayish brown spot or a lesion on the margin of the leaf. The outermost leaves and sheaths are usually first affected. Each leaf affected turns brown, dies, and decays. Frequently the death and disintegration is progressive from tip to base so that it is not uncommon to see leaves with the proximal portions still green and apparently healthy while their distal portions are entirely missing. Often a number of diseased areas are noted on the same leaf, and frequently the affected portion follows a considerable space down one margin or larger vein before extending across the leaf. The brownish, and later blackish, areas are especially noticeable on the rhizomes. These readily become black, fragile, and spongy, and soon break apart at the nodes. Occasionally one notices a plant in which it appears that the infection has worked up from a diseased rootstalk. In such cases the outer portions of the plant are first affected.

The Disease

The French observers (MM. Fischer-Piette, Roger Heim, and Robert Lami, loc. cit.) found numerous rod-shaped bacteria in the affected leaves and rhizomes but did not make any inoculation tests.

American and Canadian bacteriologists and pathologists have been less successful in finding any possibly causative organisms though many attempts have been made; however, bacteria from diseased tissue have been found.[3] At present it can not be stated positively that the bacteria obtained from diseased tissue are not invaders subsequent to, rather than causes of the disease. On many healthy and diseased specimens of eel grass, widgeon grass (Ruppia maritima), and other plants, numerous diatoms and algae of various species were noted. These however, did not appear to be injuring the host plants.

Before definite conclusions can be reached, study will be necessary at a biological laboratory along the coast, where entirely fresh material and proper control methods can be employed and where inoculation tests on healthy plants can be made.

PHYMATOTRICHUM ROOT ROT IN UTAH

The climatic and soil conditions of Washington County, Utah, where Phymatotrichum omnivorum was found this year (See Reporter 17, no. 5, p. 36. May 15, 1933) are described by B. L. Richards in the following note:

"The climate in Washington County, the only place in Utah in which Phymatotrichum omnivorum has been found, is semi-tropical with an elevation of approximately 2,000 feet, and is clearly separated in both climate and elevation from other parts of the State. The average elevation for the State is probably considerably above 4,000 feet and the climate is usually much colder with a shorter season than in Washington County. The soil in Washington County is derived from Jurassic and Triassic formation and is all alkaline in reaction. In many cases this alkali reaches the point in which it is destructive to plants." (May 15).

F R U I T D I S E A S E S

The following statement by S. R. Shapley (Genesee County, New York, in the State College of Agriculture, Departments of Entomology and Plant Pathology, Weekly News Letter) describes conditions that are probably typical in many sections of the country:

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[3] The writer wishes to acknowledge the courteous cooperation of various members of the Bureau of Plant Industry in studying diseased material sent in from various sections of the Atlantic Coast.

"In general, spraying is somewhat behind what it should be because of the unfavorable weather. Also many of the smaller growers are not giving their orchards the care they have in past years. Without a doubt, we can look forward to considerable poor quality fruit this fall with relatively few orchardists producing good quality fruit." (May 15).

PEACH LEAF CURL EPIPHYTOTIC IN MANY SECTIONS

R. J. Haskell of the United States Department of Agriculture, on a recent trip through West Virginia, Kentucky, and Tennessee, observed peach leaf curl (Exoascus deformans) to be very severe. He reports further (May 23):

"Plant pathologists with whom I talked said that it was one of the worst outbreaks in years. Also Mr. H. R. Niswonger, extension horticulturist for North Carolina, reports that this year it is very severe in the western part of that State. Every year it occurs to some extent in the northern piedmont or foothill area of western North Carolina, but the severity this year is the greatest that it has been in about seven years. He says that it is not so severe on the Blue Ridge as it is lower down.

"At Lexington, Kentucky, infection was so severe in the Experiment Station orchard where they had had difficulty in controlling it this year, that there was a necrosis occurring on last year's wood at the point of attachment of many of the badly curled shoots. The rainy weather this spring has evidently favored much secondary infection. As new leaves come out they become infected."

Reports from the various States follow:

NEW YORK: Reports from the Weekly News Letter of the Departments of Entomology and Plant Pathology indicate that leaf curl is severe in unsprayed and poorly sprayed orchards and in those sprayed too late. In Niagara County, according to J. G. Goodrich (May 29) the disease is the worst it has been in years but many growers obtained good control both with fall and spring spraying with recommended materials. Some spring Bordeaux sprayed blocks are in excellent shape.

VIRGINIA: Leaf curl on peaches is more prevalent and severe in northern Virginia this season than for many years. All neglected plantings and many of the sprayed plantings are heavily infected. The outbreak was not altogether unexpected in view of the increased prevalence of the disease last year together with the favorable weather conditions this season. Fall spraying with dormant strength lime-sulphur gave good control in those orchards where tried, but relatively few growers were able to make a spring application before the buds had swollen considerably. (A. B. Groves, May 30).

Leaf curl, which has been building up to some extent for two and perhaps three years, is certainly the worst it has been for 15 years. (S. A. Wingard, May 1[illegible]).

WEST VIRGINIA: Peach leaf curl is abundant throughout the peach growing regions of West Virginia. This is certainly the worst infection in ten years. It is not uncommon to find trees with 90 per cent of the leaves infected. (F. J. Schneiderhan, May 19).

KENTUCKY: Very severe over State. Many failed to control disease who sprayed, but there is abundant evidence that where spraying was well done control was nearly perfect. Bordeaux 3-3-50, oil 2 per cent, and calcium caseinate has given excellent control when properly applied. Mayflower has appeared to be highly resistant or nearly immune over a series of years. (W. D. Valleau, May 19).

ARKANSAS: Mr. W. G. Amstein, Extension Horticulturist, reports that peach leaf curl is worse in the main peach growing section of southwestern Arkansas than for many years. This is attributed to the fact that growers are omitting the fungicide from the dormant spray, applying only lubricating oil emulsion instead of the lime sulfur spray formerly used. The importance of this disease for several years in this State seems to be due to this fact. (V. H. Young, May 23).

I have received reports that leaf curl is very severe in the Nashville, Arkansas, section this year. The majority of the growers failed to add a fungicide to their dormant sprays. Mr. Amstein, the Extension Horticulturist, informed me that he considered 90 per cent of the leaves affected in the orchards he examined, and he felt the disease would do considerable damage this season. Strangely enough he failed to find leaf curl in the American Fruit Growers orchard at Nashville while it was prevalent in adjacent orchards. No dormant spray for leaf curl was used in the American Fruit Growers orchard but the trees have been thoroughly sprayed during the growing season with a combination of Zinc-Lime and Flotation sulfur for the past few years. This is an interesting observation but of course it cannot be concluded that the use of Zinc-Lime-Flotation sulfur combination was responsible for the lack of leaf curl. (John C. Dunegan, April 22).

OHIO: Curl is general and very bad in some cases especially where spraying has been neglected. (E. W. Mendenhall, May 23).

BROWN ROT ON PEACHES

NEW YORK (Weekly News Letter, May 29): Suffolk County (W. G. Been). Brown rot blossom blight found on peaches in several orchards. Twigs have died back three to four inches.

VIRGINIA: Blighting of both blossoms and twigs by the brown rot fungus is already common throughout the Piedmont. (S. A. Wingard, May 19).

ARKANSAS: Mr. W. G. Amstein, Extension Horticulturist, reports considerable amounts of blossom blight and fruit rot caused by Sclerotinia fructicola on Early Wheeler or Red Bird peaches in various parts of the State. (V. H. Young, May 23).

WINTER INJURY TO PEACH TREES

VIRGINIA: Winter injury to peach trees was very severe in Amherst County. In one orchard 500 trees were killed from this cause. (S. A. Wingard, May 19).

ARKANSAS: Many peach trees and apple trees as well, seem to be still showing the effects of the severe freeze of 1930, which weakened many trees so that every year a certain number continue to die. (V. H. Young, May 23).

FURTHER REPORTS ON APPLE SCAB

MASSACHUSETTS: During April, perithecial development was relatively faster than bud development, resulting ultimately in a larger percentage of mature ascospores when foliage became exposed, than even in 1932. This condition prevailed in all early and moderately early sections, whereas in the latest orchards, the spores were comparatively much slower in ripening. Generally, perithecia showed from none to 50 per cent of asci mature with spores shooting in traps when McIntosh buds were in delayed dormant stage (one-eighth to one-fourth inch green). Although a prolonged rain during delayed dormant released only comparatively few spores, yet a week later with buds in pre-pink, another rain forced a goodly portion of them into the trees. At present, with orchards in early bloom, leaves show from 25 per cent to 90 per cent of the spores discharged, with an estimated average for the earlier orchards of about 60 per cent, an unusually large large portion for the stage of trees.

To date, weather has greatly favored spraying with only two possible infection periods. One of May 25 to 26 with buds in delayed dormant, but with only slight spore discharge; and the other on May 3, after most growers had put on the pre-pink spray. So far, no new infection has been observed. Another good shower or two will just about exhaust the spore supply in many orchards. (O. C. Boyd, May 16).

NEW YORK: According to reports in the Weekly News Letter scab is prevalent in unsprayed or poorly sprayed orchards. In many cases unfavorable weather prevented timely application of sprays.

VIRGINIA: Apple scab promises to be more severe in northern Virginia than at any time in the past decade. A heavy carry-over of scabbed leaves from the past season together with the unusually cool wet season thus far have combined to give the heavy infection now prevalent. Better scab spraying has been done generally this year than last, but has not been sufficiently effective under the trying conditions to give satisfactory control in many instances. (A. B. Groves, May 30).

KENTUCKY: On unsprayed trees very severe; has caused dropping of fruit and severe leaf injury on Winesap and Arkansas Black. Very slight fruit and leaf injury on Grimes. Kennard seems highly resistant, leaves very slightly injured and the pedicels, even with several infections, are seemingly uninjured. Calyx lobe infections common on Delicious.

In sprayed orchards excellent control where sprays were applied early enough, i.e., for Delicious and Winesap at prepink before buds have separated in cluster, and on later blooming varieties in prepink. Ascospore maturity occurred while Delicious were in prepink stage and no mature spores were found subsequent to that time.

At Paducah over a period of years, scab has not been a problem on Winesap, Ben Davis, and Paducah if sprayed at pink stage as spore discharge seems to be about complete before these rather late blooming varieties reach a susceptible stage.

There is a good deal of evidence of crops being "sprayed off" with liquid lime sulfur where spraying was done too thoroughly in the belief that frequent heavy spraying would be necessary with the heavy constant rains. (W. D. Valleau, May 19).

ARKANSAS: We had considerable amounts of rather wet weather this spring which caused a **rather heavy** outbreak of apple scab, especially in poorly sprayed orchards or those in which the calyx spray was not properly timed. Foliage in particular seems to be affected, but there are considerable amounts of scab on the fruit also. (V. H. Young, May 23).

OHIO: Apple scab is general and very bad in some cases where spray is neglected in southern Ohio. (E. W. Mendenhall).

WISCONSIN: **First** scab symptoms observed on new leaves and sepals today. Varieties, Virginia and Gideon at Madison. (R. E. Vaughan, May 16).

OTHER REPORTS ON FRUIT DISEASES

APPLE: BLACK ROT LEAF SPOT IN VIRGINIA. Frog eye (Physalospora malorum) is abundant throughout the apple growing regions of Virginia. Defoliation is frequent, particularly on unsprayed trees. This is attributed to a combination of two favorable circumstances: Blight has been rather more common than usual during the last two years resulting in large numbers of blight killed trees. These of course are very generally infected with the black rot fungus and the prevalent wet weather of the past four or five weeks has made possible maximum spore extrusion. (S. A. Wingard, May 19).

Frog-eye infections are prevalent on the leaves of the trees in the more neglected orchards. In several instances the infections beneath cankered twigs and limbs have been so numerous as to give the leaves a fired appearance, and in fact several growers have brought in such material to the station here, believing it to be spray injury. (A. B. Groves, May 30).

APPLE: BLIGHT IN VIRGINIA. Blight (Bacillus amylovorus) is not as prevalent as it was last year, although it is not uncommon. Blossom and fruit blight are relatively more abundant than twig blight. In one orchard, which was severely affected with aphids, most of the young fruits were blighted and showed many small drops of exudate. The fruits were approximately one-half inch in diameter. (A. B. Groves, May 30).

APPLE: SPRAY INJURY IN VIRGINIA. Spray injury on apples has been unusually severe this season. It is probable that this can be attributed to two principal causes; first, the wet, humid weather conditions which tend to increase arsenical injuries; and second, the unusual amount of scab has weakened the infected leaves sufficiently to be a contributing factor. The injury as noted thus far has been largely to the foliage. (A. B. Groves, May 30).

PEAR SCAB IN NEW YORK: Reports in the Weekly News Letter (May 29) indicate that pear scab (Venturia pyrina) is troublesome in Dutchess, Wayne, and Orleans Counties. In Dutchess County, according to J. A. Evans, the fruit of Flemish Beauty is severely affected but only light infection is found on the leaves. M. E. Buckman reports that pear scab appears to be more serious in Wayne County than it was in 1932.

STRAWBERRY LEAF SPOTS IN ARKANSAS: Mr. W. G. Amstein, Extension Horticulturist, reported that strawberry leaf spot, Mycosphaerella fragariae, and leaf scorch, Diplocarpon earliana, have both been serious on strawberries in the main strawberry sections of central Arkansas this year, presumably due to the wet weather which we have been experiencing. (V. H. Young, May 23).

DISEASES OF CEREAL AND FORAGE CROPS

SWEET CLOVER ROOT ROT WORST ON RECORD IN ILLINOIS

A sweet clover root rot disease has been observed now and then during the last six or seven years. It caused considerable loss in 1929, a year when precipitation was considerably above normal during the spring months, and this year the most damage yet observed again coincides with an unusually wet spring. The damage has been most pronounced in the southern half of the State and loss varies from slight to a nearly complete failure. For instance, a grower from Madison County writes, "I have a twenty-acre field in which sweet clover was sown in the spring of 1932 in wheat. The land had three tons of Kankakee Lehigh limestone applied a few years ago. Last fall I had an excellent stand of Grundy County sweet clover in the stubble of this field. Early this spring this sweet clover looked like a wonderful crop. However, something went wrong and the sweet clover has been getting less and less, until now it is almost entirely dead and practically totally gone, except a little in a few spots, which also appears to be dying."

The rot is most pronounced in the upper six inches of the root; the tissues become soft and flabby and tear apart easily. The cause is unknown.

Although apparently most severe under wet conditions, the damage is not limited to wet years. In 1931, a year with rather normal rainfall, several infected fields were visited in company with Dr. Fred R. Jones, Division of Forage Crops and Diseases, United States Department of Agriculture. (Benjamin Koehler, May 22).

CROWN ROT OF ALFALFA IN WEST VIRGINIA

We have had a number of serious outbreaks of Sclerotinia trifoliorum on alfalfa. This disease is appearing in epiphytotic form for the first time since I have been in West Virginia. (C. R. Orton, May 23).

WHEAT LEAF RUST IN TENNESSEE

Paul R. Miller reports (May 15) that leaf rust of wheat (Puccinia triticina) is very abundant in all fields observed in Tennessee.

SMUT ON RYE GRASS

A specimen of Lolium perenne affected with Ustilago striaeformis was sent from Oregon by Roderick Sprague. The identification was verified by G. L. Zundel. Apparently rye grass has not been reported previously as a host of this smut in North America.

M A R K E T P A T H O L O G Y

NEW YORK MARKET PATHOLOGY NOTES

James S. Wiant contributes the following report:

ASPARAGUS: California asparagus, the season for which closed several weeks ago, arrived in exceptionally sound condition this year. Very few cars affected with moldy tips (Fusarium spp.) were observed.

POTATOES: During the early part of the season late blight (Phytophthora infestans) was found abundantly in Florida potatoes. For the past few days unusually high losses have been noted from scald, for the most part followed by bacterial soft rot (Bacillus carotovorus).

HONEY DEW MELONS: Arrivals of honey dew melons from Chile were heavy throughout the season which extended from the middle of January to the middle of May. The extreme losses from decay which occurred last season were not duplicated this year. Losses continued to be relatively high, however, from stem-end decay (Fusarium spp.) and bacterial soft rot (Bacillus carotovorus), the latter found chiefly in ripe and over-ripe melons. Mexican honey dews, the season for which partially overlapped and followed that of the South American melons, were for the most part in good condition upon arrival.

STRAWBERRIES: Southern strawberries have arrived on this market in somewhat better condition than usual. Leather rot (Phytophthora cactorum) is being found frequently in cars of Tennessee and Kentucky berries. (May 23).

DISEASES OF SPECIAL CROPS

DOWNY MILDEW OF TOBACCO

Downy mildew (Peronospora hyoscyami) was reported from an additional county, Clinton County, in Tennessee, by Paul R. Miller. E. E. Clayton found the earliest stages of mildew in all the beds examined on May 18 in the vicinity of Marlboro, Maryland. It occurred in beds that had been sterilized, in beds that had been planted last year, and beds that were planted for the first time this year. Later, however, unfavorable weather conditions checked its spread. Neil E. Stevens reported that downy mildew appeared in four beds near Glade Spring, Washington County, Virginia, on May 11. See page 63 for a report on downy mildew in Pennsylvania.

W. M. Lunn reported that in South Carolina in some cases plants set in the field are stunted and not doing well, which he ascribes to injury from downy mildew.

On the other hand R. F. Poole reports from North Carolina, "Conditions have been ideal for transplanting and for early growth activities of plants. As contrasted with last year in which plants infected with the disease when transplanted died or remained stunted for a long time, diseased plants this year have stood up well after being transplanted in the field. At present the stands are fairly uniform; far more satisfactory than was the case this time last year. Increasing the number of plant beds has had very definite psychological effects on the grower as well as making it possible for us to have an ample supply of plants. I believe the disease has been equally as severe if not more so than last year. In some of the beds the disease has killed a great many plants. The plants in some cases were much larger than those killed the two previous years."

E. Y. Floyd found mildew on Burley tobacco in western North Carolina in Buncombe, Madison, Yancey, Mitchell, and McDowell Counties. It appeared there about May 13 to 15 after rainy cold weather during the latter part of April and the first part of May. He continues, "A few of the farmers will lose their plants almost entirely where the mildew attacked them very young and the plants were too thick to begin with, but I think if clear weather continues as it did last week that mildew will not be serious in the western part of the State this year."

It may be noted that the tobacco downy mildew fungus is being reported as attacking various other plants. Most downy mildews have a narrowly restricted host range, attacking only plants that are closely related. Pepper and tomato are related to tobacco, and might possibly be affected by the same fungus, but even with these plants it cannot be stated definitely that the tobacco fungus is attacking them until such has been proved to be the case by cross inoculations. Even totally

unrelated plants such as cabbage, however, have been sent in with the statement that tobacco downy mildew is attacking them. In the case of cabbage, downy mildew is known to be caused by Peronospora brassicae which attacks only plants of the cabbage family.

WILDFIRE ON TOBACCO IN MARYLAND

There was considerable wildfire (Bacterium tabacum) in tobacco beds examined May 18 in the vicinity of Marlboro. (E. E. Clayton).

D I S E A S E S C A U S E D B Y N E M A T O D E S

FURTHER OBSERVATIONS ON THE STRAWBERRY-DWARF NEMATODE IN MASSACHUSETTS

O. C. Boyd and J. R. Christie

In a previous number of the Reporter (Vol. 16:113-114, Aug. 1, 1932) attention was directed to a diseased condition of strawberry plants which occurred in the vicinity of Falmouth, Massachusetts, during May and June, 1932. The diseased plants were found to harbor the strawberry-dwarf nematode, Aphelenchoides fragariae, and the opinion was expressed that this parasite was the principal cause of the trouble. By developing symptoms in early spring, the disease in this locality differs in its seasonal behavior from dwarf as it occurs in the southern States, but resembles more closely "red plant" and "cauliflower" disease as reported in England.

This year a survey of beds on May 5 by the writers in company with County Agent B. Tomlinson, revealed a recurrence of the disease in the Falmouth region. The trouble does not appear to be widespread but to be confined to a few fields or parts of fields. Where present it was rather severe, probably 50 per cent of the plants in one field showing pronounced symptoms. While in general appearance diseased plants resembled dwarf to a considerable degree, the resemblance to red plant was even more striking and some plants even showed a tendency towards the cauliflower type of development.

The Aphelenchoides fragariae population of affected plants was the highest yet encountered. By counting a portion and estimating the remainder it was shown that one typical diseased plant collected at random harbored at least 11,000 individuals. At that time, plant injury appeared to be at its maximum, and indications were that the injury had started with the beginning of growth of the plants. It would seem that these observations removed all doubt regarding the cause of this disease of strawberries on Cape Cod.

NEMATODES ASSOCIATED WITH SORE SHIN OF COTTON IN ARKANSAS

According to V. H. Young, Rudolf Setzler, of the Cotton Branch Experiment Station at Marianna, Arkansas, reported that there is a great deal of sore shin or damping off this spring and that nematodes were found on every specimen examined. Affected seedlings were sent to J. R. Christie, of the Bureau of Plant Industry, for examination. The report of his findings is in part as follows:

"The diseased portion of the root and hypocotyl was consistently infested with nematodes. The number varied considerably in different plants as did the species represented. Aphelenchoides parietinus was found in varying numbers in all plants examined. Aphelenchus avenae was present in most of the plants. Acrobeles bütschlii was usually present but in small numbers. Cephalobus elongatus seemed also to be rather consistently present, sometimes in very large numbers. Species of Rhabditis and Diplogaster were present, occasionally in large numbers, especially if considerable decay had taken place.

"This is about the same condition that was encountered last year in South Carolina seedlings affected with "soreshin." (Reporter 17: 10-12. Jan. 15, 1933). There Aphelenchoides parietinus seemed to be the species most consistently present, with Aphelenchus avenae fairly common. Cephalobus oxyuroides was commonly found in the South Carolina plants, sometimes in large numbers. In these Arkansas plants its place seems to be taken by Cephalobus elongatus.

"It is interesting to note that an investigator working on cotton "soreshin" in Turkestan has recently reported the occurrence of Aphelenchoides parietinus and Aphelenchus avenae in the diseased seedlings.

"We are at present unable to say precisely what role these nematodes play in connection with the various seedling troubles."

DISEASES OF TREES AND ORNAMENTALS

PINE. O. T. Wilson reported (May 20) that several trees of Pinus nigra austriaca in an ornamental planting at Cincinnati, Ohio, were badly affected with rust, Coleosporium carneum (Bosc.) Jack. The rust was identified by G. G. Hedgcock.

AZALEA. A bud rot and leaf blight caused by Sporocybe azaleae (Pk.) Sacc. has been observed in Massachusetts since 1928 but the fungus was not determined until this year. Last year 50 per cent of the buds

were killed and considerable leaf and twig injury resulted. This seems to be the first report for Massachusetts. (W. H. Davis, April 21; report accompanying specimen).

DAHLIA. Specimens from Techny, Illinois, collected by the Rev. P. Oswald, February 8, showed typical symptoms of crown gall infection (Bacterium tumefaciens). We have had very few complaints of crown gall on dahlias, and the vigor of the affected plants we have seen has not been appreciably reduced. (Philip Brierley, Division of Horticultural Crops and Diseases).

TULIP. I do not believe I ever saw so much blight (Botrytis tulipae) as is present generally in Massachusetts this spring. It is present wherever one examines tulips, and in many beds marked loss has occurred in the form of stunted growth, blasted buds, severely dwarfed, twisted, and torn leaves, and infected blossoms. It is not uncommon to find every leaf in large beds with hundreds of spots. Apparently, the prolonged wet weather we experienced during the time tulips were just starting growth greatly favored the disease. I first saw the disease about May 1. (O. C. Boyd, May 19).

IRIS. A Mystrosporium which causes the condition known as "ink" disease or bulb "scab" has been isolated from bulbous iris grown at Exmore, Eastern Shore, Virginia. The grower states in his letter of April 22, 1933, that the field in general has the appearance of having suffered from a frost as most of the tops are dying. This condition is general over the two-year old planting. It occurred in spots in a one-year old planting of bulbs taken from an old diseased field last year. He had very little trouble with the iris the first year they were in the field, but the trouble increased rapidly as the bulbs remained in the field longer. He also states that his crop is a total loss. (Edgar L. Evinger, June 1).

RECURRENCE OF TOBACCO DOWNY MILDEW IN PENNSYLVANIA

Mr. Bucher, the County Agent of Lancaster County, informed me that a grower brought him tobacco infected with blue mold from Elizabethtown, Lancaster County, on May 14. (R. S. Kirby, June 1).